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UNIVERSITY OF NATAL
PIETERMARITZBURG
SOUTH AFRICA

WATTLE RESEARCH INSTITUTE

South African Wattle Growers' Union — University of Natal —
Union Department of Forestry

REPORT FOR 1950

(THIRD YEAR)

APRIL, 1951

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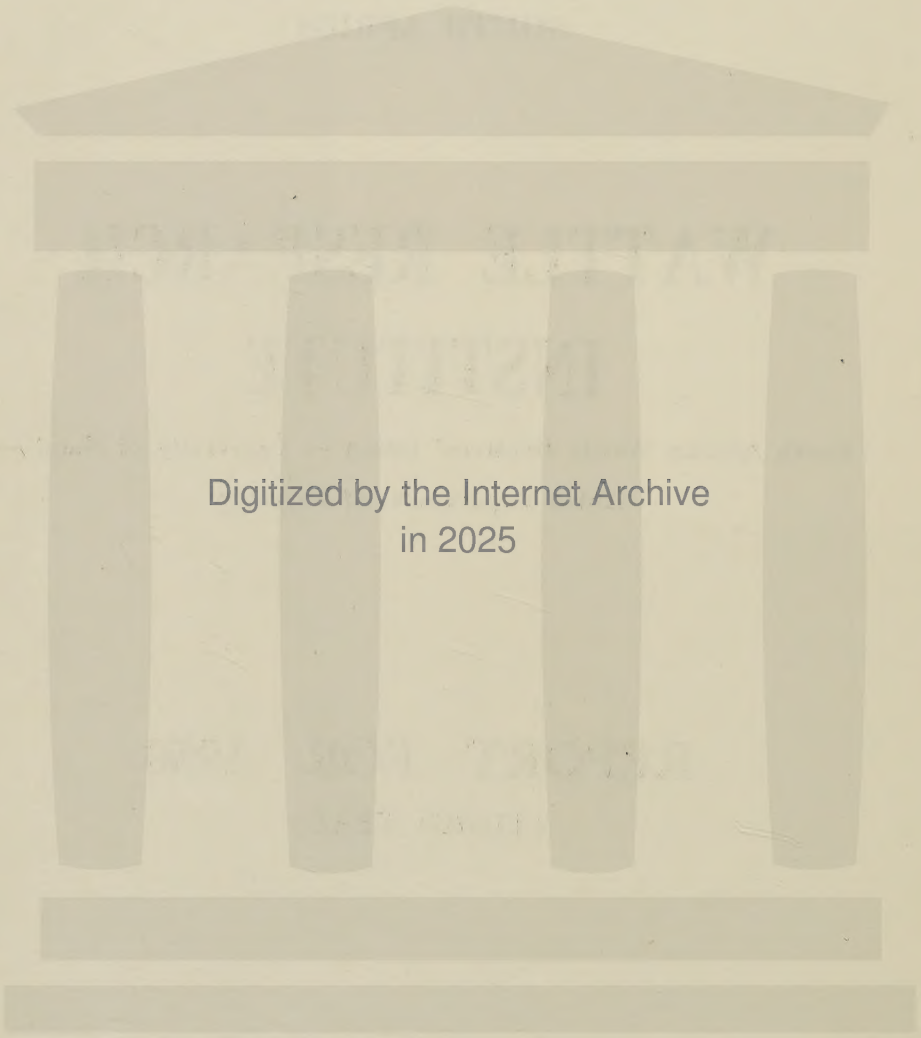

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COMMITTEE OF CONTROL OF THE INSTITUTE

Appointed by the South African Wattle Growers' Union (3):

S. Clegg, Esq.

R. B. Fyfe, Esq.

D. R. Scott, Esq.

Appointed by the Council of the University of Natal (2):

Professor S. F. Bush, M.Sc., D.Phil. (*Resigned December*, 1950.)

Principal E. G. Malherbe, M.A., Ph.D., LL.D. (Chairman.)

Appointed by the Union Government Department of Forestry (1):

H. B. Stephens, Esq., B.Sc., Dip. For.

The Director:

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

Honorary Secretary:

P. G. Leeb-du Toit, Esq., B.Com. (Registrar, University of Natal.)

STAFF

(MARCH, 1951.)

DIRECTOR:

H. Shaw, M.Sc.Tech., Ph.D. (Manc.), F.R.I.C.

Silviculture:

S. P. Sherry, M.A. (Oxon.), B.Sc. (South Africa).

Technical Assistants:

N. J. Cunningham.
M. J. Lourens.
Miss P. Schofield. (*Resigned December*, 1950.)

Genetics and Plant Breeding:

A. A. Moffett, B.Sc. (Birm.), Ph.D. (Lond.).

Technical Assistants:

Miss I. A. Pedlar. (*Resigned February*, 1951.)
R. T. Brighton.

Chemistry:

W. S. Martin, Ph.D., D.Sc. (Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, B.Sc.Hons. (Natal).

Entomology:

L. L. J. Ossowski, M.F., For.Ing., D.Sc. (Poznan).

Administration:

Miss N. van Soelen. (*Resigned February*, 1951.)
Miss E. K. Smith. (*Appointed March*, 1951.)

Non-European:

Seven.

Field Experiment Station Overseer (S.A.W.G.U.):

M. A. Stewart.

FOREWORD

The form of presentation of the Annual Report elaborated in the previous numbers has been maintained as serving adequately present requirements. It divides the activities of the Institute conveniently into two parts, Administration and Research. While the first of these has loomed rather large in these early days of development, it is to be expected that the balance will turn in the direction of Research as Administration becomes largely a routine, calling for little comment.

Already the Review of Work in Progress indicates the important part that the Field Experiment Station "Bloemendal" will play in the Institute's investigations. A number of experiments now in being or in process of establishment there are described.

Most of the deficiency in the technical equipment that has seriously held up some of the laboratory work has now been remedied. The Chemistry Section in particular has at last been able to get its activities well under way and is making good progress in dealing with the heavy back-log of bark samples, not only those arising from the Institute's own recent activities, but large numbers also inherited from the days of Department of Forestry control of wattle research. The interpretation of much of the silvicultural work awaits the results of analyses of these samples.

H. SHAW, *Director.*

April, 1951.

BUILDINGS AND PLANTATIONS

Main Building.

It may be said that 1950 was the first year in which the Institute had full and undisputed occupation of its building. Nevertheless, certain alterations had by then already become necessary, notably, as had been foreseen for some time, an increase in the power supply available in the chemistry laboratories. To meet the deficiency, a supplementary distribution board and new circuits have been installed.

To accommodate the Entomologist, for whom no provision was made in the original plan of the building, an insectary has been erected and equipped with electric light and power at a cost of £337. It remains only for water to be laid on to complete a self-contained unit suitable for the breeding and raising of the insect material required by the Entomologist.

Retaining walls have been built at the east end of the building to facilitate adjustment of the ground levels there and most of the required filling-in has been done. It will be necessary in the near future to give this area a properly hardened surface, since the slope is such that under the combined influence of traffic and heavy rain, the bank breaks and washes badly.

The bank along the north face of the building has been extended in width by some 25 feet, using surplus material from the site of the Agricultural Research Institute. This bank is now being terraced and topped up with soil to prepare it for the planting of grass and shrubs. Several permanent trees have been planted around the buildings and others will be put in as soon as sites can be cleared and prepared.

Development of the surroundings of the Institute presents a difficulty which offers no hope of solution until the nearby Agricultural Research Institute is sufficiently advanced to enable work on the site as a whole to be started. Until then, the Institute site must remain largely in its present condition of roadless isolation.

Nursery.

The nursery has been in intensive use throughout the year and has been improved by the addition of a large propagating frame. This has greatly reduced the hazards of weather and pest attack to which some of the more valuable material is exposed.

Field Experiment Station.

The farm Bloemendal, purchased by the South African Wattle Growers' Union, was handed over to the Institute early in the year for experimental work. The reorganization of the farm to make it suitable for this purpose called for much detailed planning, and a good deal of preliminary work in connection with the maintenance and rehabilitation of existing plantations has been carried out. Other work done includes the planning of a system of firebelts, the preliminary survey of certain new roads which will be necessary to open up portions of the existing plantations for exploitation and to avoid existing steep gradients, and the testing of various types of mechanical equipment prior to recommending the implements which have now been purchased for use on the property.

The agricultural crops standing on the farm when it was taken over were harvested and marketed and a portion of the older plantations has been stripped during the current season. This and other land available from areas stripped by the previous owner has been prepared and planted under experimental layouts, details of which are given in the Research section of this Report.

The Institute is fortunate in its relations with the Wattle Growers' Union Field Experiment Station Committee, consisting of Col. W. S. Slatter (Chairman) and Messrs. J. H. Holley, Jnr. and H. F. C. Kusel. At the invitation of the Union, the Institute Committee of Control nominated Mr. H. B. Stephens to serve as an assessor member of the Committee and to provide liaison with the Institute's Committee. The Institute is fully appreciative of its indebtedness to all these for the time, effort, and interest they have devoted to providing all reasonable facilities for running the Field Station. The Committee, which is responsible to the Wattle Growers' Union for administrative control of the farm, also advises the Institute on general farming matters and on practical issues arising out of the experimental work.

ADMINISTRATION AND FINANCE

Four ordinary and two special meetings of the Committee of Control were held in 1950. During the earlier part of the year, Professor Bayer again served as representative of the Council of the University of Natal in the continued absence overseas of Professor Bush. On the return of the latter in March, the Committee was restored fully to its normal personnel. At the close of the year, however, Professor Bush, on account of the pressure of other duties, resigned from the Committee to which he had rendered valuable service from its inception in 1946. He is to be succeeded by Professor Bayer who is already well-acquainted with the work of the Institute.

The Institue was deeply interested in the proposal to remove the greater part of the University to Durban, which came under discussion during the first half of the year. A memorandum was submitted to the Council of the University pointing out that against some opposition on the part of growers, the Institute had been placed on its present site only because of the great advantages of close association with the University and particularly with the Faculties of Science and Agriculture and with the Library. The eventual decision of the University Council not to proceed with the proposal was, therefore, a very welcome one to the Institute.

Consideration was given to the matter of completing a formal agreement, at present existing only in draft, between the three bodies jointly interested in the Institute, namely the South African Wattle Growers' Union, the University of Natal, and the Union Government Department of Forestry. In the course of this discussion, it was agreed that the time had come to ask the Government to reconsider the basis of its contribution to the running of the Institute. The Department of Forestry was, in consequence, requested to consider placing the Institute on the same basis as other state-aided research institutes by replacing the present fifteen shillings to one pound grant by a pound for pound grant and removing or at least raising the ceiling figure of £5,000 per year, so as to give real effect to an increased rate of grant. The Department has now replied that the Government is not prepared to make any alteration for the financial year 1951-52, but will reconsider the matter later in respect of 1952-53 and subsequent years.

In terms of the draft agreement governing the foundation of the Institute, all wattle research, other than entomology, in which government officers were engaged at the date of inauguration was to be taken over within three years. In fact, all this work was taken over at a much earlier date, and it was, therefore, formally reported to the Director of Forestry that at the end of the three year period, this condition had been complied with in full. In addition, with the concurrence of the Department of Agriculture and the Department of Forestry, an Entomologist had been added to the Institute staff.

In fulfilment of intentions expressed before the Institute was established, the South African Wattle Growers' Union has made available a sum of £400 annually for the provision of two scholarships tenable in the University for research work to be done in the Institute. It is intended that holders of these scholarships shall take up problems arising from the Institute's investigations and shall work under the immediate direction of a senior member of its staff and the general supervision of the head of the appropriate University Department. One scholarship was offered in respect of the year 1951, but no application was received for it.

Building Account.

As is mentioned under "Buildings and Plantations", certain minor additions to the buildings have been made during the year at the following cost:

	£	s.	d.
Additional Wiring in Main Building	37	10	0
Insectary	336	13	6
Propagating Frame	39	10	0
Retaining Walls	139	13	0
	£553	6	6

Research Account.

Delivery of apparatus and equipment improved greatly during 1950 and by the end of the year most, but not all, of the long-standing orders for major items had been completed. In consequence of this, a fair amount of expenditure budgeted for in previous years came into 1950. Fortunately the balance of £1,000 from the Forestal Land, Timber and Railways Company's gift of £2,500 for equipment was available and served very usefully, as in the previous year, to smooth out over the first few years the amount to be provided by the Wattle Growers' Union.

On the other hand, several appointments provided for in the Estimates have not yet been made and expenditure is less than anticipated on that account.

The Institute has been recognized by the Department of Scientific and Industrial Research of Great Britain as an approved institution for the purpose of granting relief from income tax in respect of grants and gifts made to it for the support of research.

The summarized statement of Expenditure and Income in 1950 appears below; detailed accounts and the Balance Sheet are published separately. It will be noted that the total expenditure is such that for the first time, the Department of Forestry Grant has reached its present ceiling of £5,000.

RESEARCH INSTITUTE ACCOUNT

1st January, 1950, to 31st December, 1950.

Expenditure	£	s.	d.	*Income*	£	s.	d.
Research and Administrative Staff Salaries ..	9,698	7	8	S.A.W.G.U. Grant ..	8,163	9	7
Travelling and Subsistence	1,004	17	11	Department of Forestry Grant	5,000	0	0
Laboratory and Office Equipment and Maintenance	2,213	15	6	Forestal Grant	1,000	0	0
Library	93	12	10				
Printing and Stationery	201	1	10				
General Administration	448	7	4				
Building Additions (excluding new wiring) ..	503	6	6				
	£14,163	9	7		£14,163	9	7

STAFF

At the beginning of March, Mr. C. G. Gordon-Gray, an honours graduate of the University of Natal and a former commissioned officer of the Royal Artillery, joined the Chemistry Section to assist in the work on bark and, more particularly, on methods of analysis.

Despite repeated efforts through a number of channels, a suitable plant physiologist has not been found and this very important post in the Institute remains unfilled.

Two technical assistants, Miss P. M. Schofield and Mr. R. T. Brighton, joined the Silviculture and Genetics Sections respectively shortly after matriculating. Miss Schofield, however, resigned at the end of the year to take up another appointment.

A seasonal need for assistance in the Entomology Section was met by taking on several students of the University Departments of Agriculture and Zoology as temporary assistants during January and February, July, and December. This arrangement proved very convenient at this early stage of the work and will no doubt be repeated profitably for peak periods of survey and insecticide trial assessment. A full time assistant, however, has now become necessary to ensure continuity of the routine work and also to help throughout the year with maintaining the stocks of insects necessary for various phases of the work of the Section.

The post of Secretary-Typist, vacant for some months at the end of 1949, was filled when Miss N. van Soelen came early in January.

Although not a member of the Institute staff, Mr. M. A. Stewart, who was appointed in February as Overseer of the Field Experiment Station, has worked in close collaboration with the Institute's Research Officers in laying down the experiments to be carried out there.

The hitherto excellent health record of the staff was somewhat marred during the year by developments which necessitated absence on leave for surgical treatment of two members of the Institute staff and the Farm Manager. During Mr. Stewart's absence, Mr. Cunningham of the Institute staff was temporarily seconded to the Field Station to supervise operations there.

ADVISORY WORK, COMMITTEES, CONFERENCES, ETC.

Advisory.

Enquiries increased steadily throughout 1950 and by the end of the year, 147 letters had been written in reply. The geographical distribution continued to widen as the following list will show. Three-quarters of the enquiries originated in the Union and the rest came from Fiji, Great Britain, Hawaii, Kenya, Malaya, Mocambique, New Zealand, Northern Rhodesia, Nyasaland, Southern Rhodesia, Swaziland, Tanganyika, Uganda, and the United States of America. Silviculture accounted for over one-third of the advisory letters (51), whilst there was a very sharp increase in those concerning pest control (38). Of the rest, the chief subjects were chemical analysis, soils, and fertilizers (10), bark and extract (10), valuation, survey, etc. (8), and timber utilization (7).

Several of the enquiries about tanning materials called for analyses by the Chemistry Section. Although the analytical methods were not then running smoothly on routine lines, it was possible to get the required information.

Fourteen estates were visited by the silviculturist and ten by the entomologist for the purpose of giving advice in the field. As several of these were visited more than once, the total number of visits involved approached thirty. Of particular interest among these was the journey made at the request of a large wattle-growing company to the Melsetter-Chipinga area of Southern Rhodesia. The occasion for this visit was an outbreak of chafer-beetle causing severe damage to young trees. Such an attack has not occurred in the Union, but it was felt that the opportunity should be taken to obtain first-hand information about the outbreak and to try out control measures. The information thus gained will be invaluable if the endemic occurrences of chafer-beetles in South African plantations should ever reach epidemic proportions.

Advice was given during the year on the layout, equipping, and staffing of factory laboratories.

In the absence of any organized parties, the number of visitors to the Institute, on record as 46 including 12 from outside the Union, was somewhat below the figure for 1949. Attention must again be called to the need for growers to make definite appointments whenever possible. Several members of the staff spend the greater part of their time out on field work, and chance callers have often been disappointed to find that the person they wished to see was not available.

Enquiries on the subject of timber utilization have increased, both in number and in breadth of interest, and representatives of a number of industries have visited the Institute for discussions. The Institute continues to act in an advisory capacity and as a medium for the collection and exchange of information. In several instances, special sets of data have been assembled and supplied to enquirers and in this connection it is much to be regretted that the questionnaire to growers about timber production did not meet with a better response. The information called for would have been invaluable if it had been available. There is a very wide gap, and innumerable difficulties have to be surmounted, between exploratory enquiry and the coming to fruition of any particular project. It cannot be said, therefore, that any major development is just round the corner, but several distinct possibilities are still being actively investigated.

The Institute again assisted with preparations for the Wattle Industry Exhibit at the Royal Show held in Pietermaritzburg in June. Because, however, of the pressure of field work, particularly in preparing for the laying down of new experiments, the part played by the Institute was less than in previous years.

Committees, etc.

In June, the Director attended the Annual Meeting of the Research Advisory Council of the Leather Industries Research Institute, held this year at Rhodes University College, Grahamstown. This provided an opportunity to renew first-hand acquaintance with the work in progress at the Leather Research Institute and to discuss problems of common interest with the staff there.

The Director and Dr. Martin attended a meeting of the Leather Research Institute's Wattle Technical Committee, held during the visit of Dr. Shuttleworth and Mr. Roux to Pietermaritzburg for the Annual Congress of the Wattle Growers' Union.

The Director attended all the meetings of the General Committee of the South African Wattle Growers' Union and, together with Mr. Sherry, served on the Union's Research and Technical Committee and on the Field Experiment Station Committee.

Conferences, Lectures, Meetings, etc.

In October, the Director attended a Conference on Weed Control organized by the University of the Witwatersrand. Field experiments were visited and much valuable information was exchanged. During the year, visits were paid to the National Chemical Research Laboratory in Pretoria to discuss and arrange collaboration and to a number of industrial concerns to collect technical information on plant and processes.

In June, the Director attended two meetings in Greytown to give technical information and advice in connection with the power and water requirements likely to arise if a pulp mill were to be established in the neighbourhood. Plans are now afoot to provide electricity and to ensure water supplies by damming the Umvoti River.

During July and August, Dr. Martin attended the Fourth International Congress of Soil Science at Amsterdam and joined in the post-Congress excursions through Holland and Belgium. Delegates from all parts of the free world to the number of 600 attended the Conference and over 100 soil workers participated in the excursions. The plenary sessions and the main sectional lectures were devoted to reviews of the advances in knowledge of various branches of soil science since the previous congress held at Oxford, England, in 1935. These were exceptionally useful, especially to those who had been practically isolated from workers in the same field during the war years. The most valuable part of the Congress lay in the informal discussions of soil problems during the Congress and especially on the excursions, where differences of view-point and of nomenclature were threshed out on the land itself. A prominent feature of the work in Holland, and to a lessser degree in Belgium, was the close liaison between the research teams, the field advisers, and the farmers. This resulted in a rapid appreciation of the farmers' problems by the research teams and the almost equally rapid application of the results of research in the practical agriculture of the country.

Advantage was taken of this tour in Europe to visit most of the major agricultural research stations in Britain to learn something of the latest lines of work and of the equipment now being used. These visits were most valuable to a member of a young Research Institute, both in the matter of equipment and in the study of modern methods of research. More valuable still was the fact that personal contact was made with workers on similar problems and resumed with many old colleagues. Thanks are due to the Directors of the Research Stations and to many workers in each station who gave up time unstintingly to explain their work.

Mr. Sherry delivered a short course of lectures on wattle silviculture and management to fourth year students in the Faculty of Agriculture of the University of Natal. He also gave one day to lecturing and demonstrating on the same subject to senior students at Cedara College of Agriculture.

Mr. Sherry and Dr. Ossowski gave addresses on wattle silviculture and wattle protection respectively to a farmers' association meeting at Highflats and to a meeting of company estate managers. In this connection, the attention of local associations is drawn to the fact that whenever research officers of the Institute are in any particular area for a few days, they will gladly arrange to discuss problems with individual growers or to address meetings. On several occasions, although advance notice has been given, growers have failed conspicuously to take advantage of such opportunities.

The Director addressed a meeting of the Pietermaritzburg Rotary Club on the Nature and Organization of Research.

LIBRARY

During 1950, 32 books and 187 bulletins were received in the Library, making totals of 149 and 890 respectively. In addition, 47 scientific periodicals and 16 reports are now regularly received, 28 of them by interchange or gift. Some 80 research institutes and libraries now regularly receive the Institute's Reports and this constitutes a valuable medium of contact with other research organizations.

The Library is indebted to Mr. N. J. Cunningham for the gift of a back volume of "Farming in South Africa" and to the publishers of "Endeavour" for a collection of past issues as well as for current numbers.

Much time has been spent during the year on the classification and indexing of the literature in the Library and substantial progress has been made. Under prevailing conditions, however, with no library-trained personnel available, this is a lengthy and laborious task. Nevertheless, the accessibility of the literature is of such importance that this work must continue to take high priority.

Growers have been slow to take advantage of the facilities offered by the Institute Library and a large amount of literature of great potential value to them lies idle. There is a particularly large assortment of bulletins on timber handling and utilization with which timber-conscious growers should be familiar.

ACKNOWLEDGMENTS

The Institute is happy to acknowledge gratefully its indebtedness to the undermentioned individuals and groups for assistance rendered in a variety of ways during 1950.

To the South African Pulp and Paper Industries, Limited, for a gift of paper-machine wire used in the construction of the insectary.

To the Estates Research Department of the Natal Tanning Extract Company for co-operation in the use of their Tifa spraying machine and for facilities provided for experiments in the Company's plantations.

To the Head Office staff of the same Company for help and guidance in drawing up the various schedules required for the Field Experiment Station.

To Dr. H. K. Munro, of the South African Division of Entomology, and to the Entomologists of the Commonwealth Institute of Entomology and of the British Museum (Natural History) for assistance in identifying and naming entomological material.

To Dr. F. Yates and the Statistics Department of Rothamsted Experimental Station for assistance in the analysis of field data.

To the Field Experiment Station Sub-Committee of the South African Wattle Growers' Union for their support and guidance in organizing and equipping the Field Station.

To all the growers who, often at considerable inconvenience to themselves, have co-operated in regional field trials.

To Major J. F. Handley, Superintendent of University Grounds and Buildings, for the provision and supervision of labour for work on the Institute surroundings.

PART II. RESEARCH REPORT

PROGRAMME OF EXPERIMENTAL WORK IN PROGRESS AND PROJECTED

The following is a list of changes in and additions to the research programme. The Silviculture, Genetics, and Chemistry programmes appeared in full in the Report for 1949 and the Entomology programme in the Report for 1950.

(a) SILVICULTURE.

PROJECTED EXPERIMENTAL WORK.

1. Effect of Season of Green Pruning on Disease Incidence.

A replicated experiment will be laid out at Bloemendal in 1951 to test the effect of green pruning of side branches on the incidence of wood-rot infection. Treatments will consist of green pruning of all side branches up to one-third of the total height of the tree during the second year from re-establishment, and one plot in each block will be so treated at two-monthly intervals during the year. Counts of trees infected with wood-rot will be made at intervals and the results compared with those from unpruned controls.

2. Long-term Study of the Effects of Brushwood Burning on the Site and on the Crop.

A site will be selected at Bloemendal on which comparable adjacent plots will be managed under systems of burning and non-burning of brushwood respectively. The experiment will be continued indefinitely and regular observations on run-off, soil loss, soil water relations, chemical and physical changes in the soil, incidence of disease and insect attack, and yield variations will be maintained throughout the life of the experiment.

3. Thinning Regimes in Relation to Length of Rotation and Yield.

Two experiments of this type have already been laid out on second and third quality sites at Broadmoor and Bloemendal respectively. A suitable first quality site has now been located at Yarrow (Howick District) and the experiment will be repeated on this site during 1951.

4. Comparison of the Costs of Establishing Wattle Plantations by Direct Sowing and by Planting Seedlings Raised in a Nursery.

A replicated experiment will be laid out at Bloemendal in 1951 in which the following methods of establishing wattle will be compared:

(*a*) Direct sowing of treated seed in continuous drills, both prior to stripping in the spring and after the removal of the timber during the autumn.

(*b*) Planting of seedlings raised in a nursery in individual containers of various types.

Detailed costs of each treatment will be kept from the outset and individual plot yields will be recorded when the trees are finally stripped at maturity.

(b) ENTOMOLOGY.

WORK IN PROGRESS.

1. Wattle Bagworm.

(*a*) Bagworms from areas sprayed with insecticides will be kept under observation to determine the effect of the insecticides on bagworm parasites.

(*b*) Bagworms from felled areas in their fifth and sixth instar will be kept under observation to determine whether bagworms in their later instars can, without adequate food, reach the pupal stage without passing through the normal number of instars, emerge, and reproduce.

(*c*) Spraying of bagworm-infested areas will be done during the copulation and pre-hatching period to see whether spraying at that time can stop or reduce hatching.

2. Soil Insecticides.

Different brands of soil insecticides will be tried at different rates and by different methods of application to determine the effect and best way of application against chafer-beetle larvae and cutworms in wattle plantations.

REVIEW OF WORK IN PROGRESS

(a) SILVICULTURE.

1. Thinning Experiments Initiated by the Department of Forestry.

The thinning experiments in black wattle at Grovedale (Vryheid District) and Spring Valley (Iswepe District) and a further two thinning experiments in green wattle at Cramond (Albert Falls District) were harvested during the year and a large number of sample trees were measured and sampled for bark analysis.

2. Thinning Experiments Initiated by the Institute.

The replicated thinning experiment established at Broadmoor (Wartburg District) last year was thinned twice during the year and the trees are growing satisfactorily. A similar experiment has been established at Bloemendal (Pietermaritzburg District), on a rather poorer site, during the year under report.

The experiment on the Umvoti Wattle Company's estate at Kranskop to test the effect of thinning on gummosis incidence was also thinned twice during the year. The trees are now growing well despite having sustained a double set-back in the form of fairly severe hail damage followed by an attack by *Cerambycid* beetles, resulting in the loss of a high percentage of the leading shoots throughout the plantation. No great differences attributable to treatment have been observed as yet.

3. Weed Control Experiment.

Owing to the extreme irregularity in natural regeneration and lack of homogeneity of weed cover over this area at Cramond, it proved impracticable to apply any particular treatment simultaneously in all the blocks. The costing data from individual replicates could not, therefore, be regarded as strictly comparable, and it was considered wiser to abandon the experiment than to expend further time and labour upon it, with the strong probability that the final results would be inconclusive. The experiment will be repeated when a more homogeneous site can be found.

4. Row-Espacement Experiment.

A replicated experiment has been established at Bloemendal to test the effect of row-espacement on yield, with special reference to maintenance costs. The espacements represented are 6, 9, and 12 feet respectively and a split-plot arrangement will permit the effect of weeding as opposed to non-weeding to be tested as well. The treatments are replicated five times in a randomized block arrangement.

5. Work in Co-operation with Other Sections.

(*a*) Assistance was given to the Geneticist in demarcating plots for a progeny trial and in planting this trial at Bloemendal.

(*b*) The fertilizer trial laid down by the Soil Chemist at Honey Grove was thinned and pruned during the year and heights of all trees were measured. In addition, two new fertilizer experiments planned by the Soil Chemist were demarcated at Bloemendal and will be established in 1951.

(*c*) Assistance was given in the demarcation of four experiments of eight plots each laid down by the Entomologist in different areas to test the effect of uncontrolled bag-worm attack on bark increment.

(*d*) A considerable amount of time was spent at Bloemendal during the year organizing current operations and planning future management of the existing wattle stands on the property. Temporary sample plots were laid out in most of the younger stands to assist in drawing up a thinning programme, several new roads were surveyed and pegged, and a complete fire protection scheme was planned and executed.

6. Collection of Material for Other Institutes.

Several samples of black and green wattle bark have been collected and despatched to the Leather Industries Research Institute at Grahamstown for use in investigations into the structure of the wattle tannin molecule.

A set of wood samples for preliminary investigations into the chemical composition of wattle timber by the National Chemical Research Laboratory of the C.S.I.R. was collected at Broadmoor and despatched to Pretoria.

(b) PLANT BREEDING AND GENETICS.

1. Breeding.

(*a*) *Inbreeding green wattle* (Acacia decurrens). Since the yield of seed from selfing the first inbred generation of green wattle in 1949 was very low, it was decided to self again as many as possible of the selected trees so that families sufficiently large to allow genetical analysis could be obtained. Seventeen of the 25 trees used in 1949 were selfed in the 1950 season; the other eight trees had grown so tall that flowering branches were inaccessible. The results are summarized briefly as follows:

Trees selected	Branches bagged	Bags torn	Failed to set pods	Set seed	Total seeds harvested
17	280	73	123	84	1,291

The trees again showed wide differences in self-fertility. There was considerable correspondence in their behaviour over the two seasons; seven trees which had low self-fertility in 1949 again gave a poor seed-set, while the more fertile trees in 1949 gave, on the whole, the highest yields of seed in 1950. Over 1,600 seeds from the second inbred generation have now been obtained; these will be sown in the spring of 1951.

(*b*) *Interspecific hybrids.*

(i) *Green* x *black wattle hybrids* (A. decurrens x A. mollissima.) Five sister hybrid trees in family G35 and one in G33 at Sweetwaters were selfed and, in some cases, back-crossed to both green and black wattles. The set of selfed and natural seed was very much of the same order as that of the previous season, being 0·81 and 2·63 seeds per pod respectively as compared with 0·50 and 2·5 seeds per pod in 1949.

Three of the hybrid trees were back-crossed to black wattle and one to green wattle using the parent species as pollen parent in each case. The results of these pollinations as regards seed set are as follows:

G35 *hybrids. Seed set following different pollinations.*

Hybrid number	x Black wattle		x Green wattle		Selfed		Open pollination	
	Number of seeds	Mean per pod	Number of seeds	Mean per pod	Number of seeds	Mean per pod	Number of seeds	Mean per pod
G35.19 ..	130 (2)	3·82	—	—	119 (11)	1·03	40	1·74
G35.21 ..	594 (5)	3·67	25 (3)	1·47	158 (9)	0·82	103	2·58
G35.24 ..	—	—	—	—	91 (6)	0·63	139	3·48
G35.25 ..	233 (2)	4·66	—	—	114 (8)	0·67	113	2·83
G35.30 ..	—	—	—	—	15 (1)	0·88	—	—
Mean ..		4·05		1·47		0·81		2·66

Figures in brackets give the number of branches bagged successfully.

The figure for the green wattle back-cross is open to some doubt since, at the time of maximum flowering of the hybrids, green wattle flowering was largely over and some difficulty was experienced in obtaining pollen.

Attempts were made to produce further green and black wattle hybrids and to cross these species using black wattle as female parent as well as pollen parent. Using green wattle as female parent and black wattle as male parent, a total of 108 seeds was obtained from four trees. As emasculation of flowers is not feasible, these seeds may be either hybrid or the result of self-pollination. The results of the reciprocal crosses cannot be assessed until the end of 1951 as black wattle takes 14 months to ripen seed.

(ii) *Other attempts at hybridization.* Cross-pollinations were made between silver wattle (*A. dealbata*) and black wattle using silver wattle as both female and pollen parent. Fifteen seeds have been collected from the silver tree, but it will be 12 months before the results of the reciprocal cross will be known.

Cross-pollinations between black wattle and *A. baileyana* were also made using black wattle as the female parent. Reciprocal pollinations were not attempted as the *A. baileyana* proved to be largely female-sterile.

Golden wattle (*A. pycnantha*) pollinated with black wattle pollen failed to set any pods.

(*c*) *Black wattle selfed.* Selfed and natural progeny from 13 trees of black wattle were grown in pots in the nursery. Six of these families, 27/50—32/50, were from trees bagged at Sweetwaters in 1948. Five families were from trees bagged by Dr. Philp and Mr. Sherry in 1943. Of these trees, one, family 33/50, was on the Natal Tanning Extract Company's estate at Seven Oaks and four, families 34/50—37/50, on Mr. Fyfe's farm "Yarrow" at Howick. The other two families, 38/50 and 39/50, came from trees bagged by Mr. Handley, acting on Dr. Philp's instructions, on his farm "Mowbray" at Ahrens.

In families 29/50, 30/50, 31/50, and 32/50, the percentage germination of selfed seed was almost identical with that of natural seed. In the remaining families, the germination of selfed seed ranged from 4 per cent. to 24 per cent. lower than that of natural seed. Significant differences occurred also in the percentage germination between trees.

Segregation for genetical characters was observed in a number of families. In some cases, the segregation was clear cut and it was possible to establish with reasonable certainty the number of genes controlling the character. Where this was the case, it was possible to calculate the minimum natural crossing in the trees concerned. The ratios given by the more clear cut segregating characters are summarized on page 22.

Where families are small, the ratios suggested as explaining the segregation are purely tentative and must be confirmed by further breeding tests.

Family 32/50 segregating for round and pointed pinnules showed a deficiency of recessive types. As seed from each bagged branch had been sown separately, a test for heterogeneity was possible. The test showed that the deficiency of recessives was common to all branches and was not, therefore, due to contamination.

The yellow-green seedlings in family 37/50 were a distinctive type and no difficulty was experienced in scoring this character. Unfortunately the small number of seedlings in the family made it impossible to establish the ratio with reasonable certainty, but the segregation suggests that the yellow-green seedlings may be due to complementary factors.

Families 37/50 and 38/50 both segregated for what appeared to be the same character "blotchy", but the two families gave different ratios. The ratio of normal to "blotchy" in family 37/50 could be interpreted as a 3 : 1 segregation, while that in 38/50 approached closely to a 15 : 1 segregation. If these ratios are correct, the segregations could be explained as being due to duplicate factors.

Segregation of recessive characters in selfed and natural seedlings of black wattle.

Family No.		Selfed seedlings		Natural seedlings		Min. % natural crossing	χ^2 Selfs only
		Round pinnules	Pointed pinnules	Round pinnules	Pointed pinnules		
27/50	Observed ..	126	49	129	4		0·621
	Expected 3:1	131·25	43·75	99·75	33·25	88	P=0·50—0·30
28/50	Observed ..	104	33	107	6		0·051
	Expected 3:1	102·75	34·25	84·75	28·25	79	P=0·90—0·80
32/50	Observed ..	223	51	129	9		5·961
	Expected 3:1	205·5	68·5	103·5	34·5	74	P=0·02—0·01
		Blue-green leaves	Chlorotic	Blue-green leaves	Chlorotic		
34/50	Observed ..	206	51	135	6		3·643
	Expected 3:1	192·75	64·25	105·75	35·25	83	P=0·10—0·05
		Normal blue-green	Lighter green	Normal blue-green	Lighter green		
35/50	Observed ..	23	9	124	2		0·042
	Expected 3:1	24	8	94·5	31·5	94	P=0·90—0·80
		Normal spaced pinnules	Wider spaced pinnules	Normal spaced pinnules	Wider spaced pinnules		
36/50	Observed ..	31	9	78	3		0·033
	Expected 3:1	30	10	60·75	20·25	85	P=0·90—0·80
		Normal blue-green	Yellow-green	Normal blue-green	Yellow-green		
37/50	Observed ..	10	11	142	6		0·357
	Expected 9:7	11·81	9·19	83·25	64·75	91	P=0·70—0·50
		Normal seedlings	Blotchy seedlings	Normal seedlings	Blotchy seedlings		
37/50	Observed ..	12	9	144	4		2·682
	Expected 3:1	15·75	5·25	111	37	89	P=0·20—0·10
38/50	Observed ..	61	4	127	2		0·001
	Expected 15:1	60·94	4·06	120·94	8·06	75	P=0·95—0·98

Over 300 branches were bagged for selfing on 20 of the trees selected at Bloemendal for progeny testing. Natural seedlings grown for the progeny trial showed that a number of these trees were heterozygous for recessive characters.

2. Seed Germination.

Further tests established fairly conclusively that the differential effect of hot water treatment on germination is due to differences in sensitivity of the seed coats of the various size groups. Tests were made on the recovery of the seed from treatment and the effect of storage after treatment. Storage increased the percentage germination in all treatments except that at the lowest temperature (80°C.). The maximum germination following treatment at 90°C. and at boiling point occurred after 15 days storage and showed a drop after 60 days storage. Following the more severe treatments, the maximum germination was reached after a longer period of storage. An Advisory Bulletin based on this work appears on page 32 of this Report and a full account has been prepared for publication elsewhere.

All seed of selfed and natural families and that for progeny trials, sown in the nursery, was chipped with a razor to induce germination instead of being treated with hot water. The chipping method proved to be very satisfactory; the germination percentage was high and all the seedlings appeared above the surface of the soil within two or three days of each other, greatly facilitating the scoring of genetical characters.

3. Colchicine Treatment.

A further 1,200 seeds of black wattle were treated with colchicine to replace losses of previously-treated seedlings in the field. Six concentrations of colchicine ranging from 0·02 per cent. to 0·07 per cent. by intervals of 0·01 per cent. were used. Two hundred seeds were treated at each concentration, half being soaked for 24 hours and half for 48 hours. Five months after treatment, 163 seedlings survived and were growing well in pots.

Combining the 24 and 48 hour treatments, only four seedlings survived after treatment with 0·07 per cent. solution while at the other end of the scale 55 seedlings survived after treatment with 0·02 per cent. solution.

4. Twin Seedlings.

Chromosome numbers were counted in both seedlings of eight pairs of twins and in one seedling of each of 16 pairs of twins. All seedlings examined had the normal diploid chromosome number.

Progress in this line, however, has been unsatisfactory. Suitable conditions were not available for raising weakly seedlings, with the result that losses of smaller seedlings were unduly high. A further difficulty was encountered in making chromosome counts. Root tips fixed in 2BE showed good fixation, but it was found impossible to stain the chromosomes sufficiently well to make counts. This line of work has been left in abeyance until the propagating frame becomes vacant, so that seedlings can be raised under more favourable conditions, and until the question of fixation and staining of the chromosomes has been cleared up.

5. Progeny Testing of Parent Trees.

A progeny trial was started using seed which had been collected from a number of black wattle trees at Bloemendal in 1949. There were significant differences between some of the trees for seed weight, seed volume, and fertility. The seed, which was chipped instead of being hot water treated, was sown in pots in the nursery on the 4th and 5th September, 1950. Germination was even and rapid and the percentage germination high, the lowest germination being 75 per cent., the highest over 97 per cent., and the mean 89 per cent. A considerable number of trees showed segregation for recessive seedling characters. As mentioned above, a number of these trees have been selfed.

Seedlings were transferred to Bloemendal and were planted in the field on the 28th December, 1950, a symmetrical incomplete block arrangement giving six replications of the progeny of each of 25 trees being used for the test. No major difficulties were experienced in transplanting; seedlings took well and grew rapidly. A certain amount of loss was caused by insects, but prompt action by the Entomology Section prevented losses reaching serious proportions. Two months after transplanting, only 35 seedlings out of some 2,500 planted were missing and these have now been replaced.

6. Cytology.

Following the difficulty, mentioned above, in staining chromosomes in roots when 2BE was used as a fixative, ten fixatives were tested to determine the most suitable for wattle root tips. After fixation, sections were stained in crystal violet using the normal routine. Medium Flemming, Strong Flemming, 2BD, and a modified form of 2BE with increased chromic acid content all gave good fixation and the chromosomes stained readily. Benda, 2BE, and 2B gave good fixation, but staining was very faint even using various modifications of the staining technique. Staining was very deep following the Navashin type of fixatives, but fixation was poor and excessive clumping of the chromosomes made accurate counts difficult. Squash methods were found to be unsatisfactory for wattle root tips.

(c) CHEMISTRY.

1. Soil Survey.

The reconnaissance survey of Bloemendal has been completed. The main rocks of the farm are shales with numerous basic igneous intrusions. These sills of dolerite vary in thickness from a few inches to many feet and in one instance a red soil more than 50 feet deep lies within a yard or two of an outcrop of hard blue shale. The general soil type is clearly influenced by geology to a greater extent than it is by climate, and the presence of these scattered basic intrusions in the shales will make any accurate detailed soil survey difficult. It will be better, therefore, in the beginning, to make detailed soil surveys of actual sites of experiments than to attempt a survey of the whole farm.

About 50 soil samples taken in the course of the reconnaissance survey have been examined in the laboratory and the soils as a whole must be classed as clays by mechanical analysis. From the practical agricultural standpoint, however, they behave as clay loams or even as loams because the clay fraction consists largely of sesquioxides, the rocks having weathered under hot, humid conditions. Both the brown and red soil types are acid and rarely show more than a trace of calcium or potassium. The available phosphate is low throughout, but not as low as one would expect, probably because much of the land has been used at one time or another for fertilized field crops. The main differences between the two soil types are in the questions of root-room and, in some cases, drainage, both of which are important in wattle growing.

2. Fertilizer Experiments.

The first height records from the Honey Grove fertilizer experiment have been analyzed in the Department of Statistics at Rothamsted. In his notes on the analysis, Dr. Yates stated that the design of the experiment has been very successful and that there has been a response of 20 per cent. to a double dressing of phosphate and one of 10 per cent. to a double dressing of potash. There has been no response to nitrogen or lime. Although there can be no final decision on the results of the experiment until the trees are harvested eight or nine years from now, it is hoped to follow the progress of treatment by taking annual height and girth records. It should be noted that this experiment is on a sandy soil developed on Table Mountain Sandstone.

Another experiment of the same design has been marked out at Bloemendal, but the treatments have not yet been applied.

An experiment to compare the effects of five phosphatic fertilizers has also been marked out at Bloemendal on a site adjoining the major fertilizer experiment.

3. Bark Analysis.

Most of the remaining equipment required for this work arrived early in the year and work began on the International Procter Method in March. It was decided first to analyze a large number of replicates of the same bark sample to acquire the necessary bench technique and to assess the inherent difficulties in the method of analysis. Many snags appeared, but most of these were overcome by the end of the year and routine analyses of bark samples from silvicultural experiments were undertaken.

All analyses are carried out in duplicate by the Official (Procter) Method of the International Society of Leather Trades' Chemists and by a commercial method to discover what relation, if any, holds between the two methods. Since early December, a proportion of samples has also been analyzed by the method of the American Leather Chemists' Association. The aim of this work is to find an analytical method which is more simple in operation than the Procter method, but which will give comparable results. By the end of the year, 321 determinations had been made.

In addition to the above exploratory work, some samples of bark from outside sources were analyzed for advisory purposes. Arrangements have also been made to begin the routine examination of samples submitted by the Government Inspector of Wattle Bark. This work was formerly done at Cedara, but was stopped in 1943 on account of staff difficulties.

As soon as it was considered that the laboratory organization was working smoothly, the Institute joined by invitation in the co-operative tests being carried out by the Permanent Technical Committee of the South African Wattle Extract Manufacturers' Association. In this work, identical samples of bark or extract are analyzed in each of five different laboratories according to a definite set of specifications drawn up before each test and the results are examined statistically. The Institute has found this work most valuable in directing attention to the basic factors involved in tannin analysis and even to studying the efficiency and accuracy of standard laboratory equipment such as ovens and thermometers.

For instance, a study of moisture determination of ground bark at different oven temperatures at first gave the anomalous result that drying at 98°C. gave a higher moisture content than at 103°C. Then it was found that there was considerable variation in temperature in different parts of the same oven and that the temperature indicated by the standard oven thermometer bore little relation to the actual temperature of the drying dishes. In another case, the standard oven thermometer was found to be several degrees out owing to faulty graduation.

In a general consideration of the problem of grading bark by analysis, it was at first thought that if only it were possible to obtain a true sample of bark from a consignment, then the analytical part would be easy. The results of these co-operative tests to date have emphasized the fact that normal methods of quantitative chemical analysis do not apply to tannin solutions, and that the empirical methods so far suggested must be adhered to to the smallest detail of time, temperature, and calibration of apparatus before different operators and different laboratories can hope to obtain concordant results from one sample of bark.

(d) ENTOMOLOGY.

1. Bionomy of Wattle Bagworm.

(*a*) *Biotic potential.* Studies were continued to determine the biotic potential of the wattle bagworm. Sex factor and fecundity were determined for 16,203 bagworms, collected from 205 trees in ten different plantations.

Data so far obtained show that the sex ratio of wattle bagworms able to reproduce (June, July) is one female to three males.

(*b*) *Abundance and mortality of bagworms feeding at different heights on wattles.* The sample trees were divided into six foot sections and the bagworms collected separately from each section. All specimens were dissected to segregate old bags from new ones and to determine the sex and causes of natural mortality.

From 13 trees in three different plantations, 3,682 bagworms up to the fifth instar were collected, and from 214 trees in 13 different plantations, 18,129 bagworms in their prepupal and pupal stages.

On young trees, up to 12 feet high, bagworms are to be found mainly in the top of the tree, the lower part usually being free. No marked difference in mortality in all instars including the pupal stage was found between bagworms from the lower and higher sections.

In older trees, up to 40 feet high, the number of bags increases with the height of the tree, while the mortality decreases, but only in the prepupal and pupal stages. The mortality of bagworms up to the fifth instar is fairly even through all sections of the tree except the lowest part, where the mortality is somewhat higher. In the prepupal and pupal stages, the mortality is highest (up to 100 per cent.) in the lowest parts of the trees inside the plantation and is due mainly to *Isaria.*

(*c*) *Population study.* The detailed population study was continued in seven plantations over an area of 400 acres.

2. Chemical Control.

In collaboration with the Natal Tanning Extract Company, whose Estates Research Department carried out the application of insecticide by means of the Todd Insecticidal Fog Applicator (Tifa), the effect of BHC and Toxaphene was determined during the 1949-50 bagworm season. BHC was used on two blocks in Highlands Estate and one block at Mistley, the latter in conjunction with experiments carried out by Department of Agriculture entomologists. On one block in Spring Grove, BHC, Toxaphene, and the base oil diesoline were compared. The results of these trials up to one week after spraying have already been reported (see Wattle Research Institute Annual Report for 1949, page 36).

All these blocks were re-examined from five to seven months later, when it was found that a further kill amounting to 2·5—21·4 per cent. increase over natural mortality had occurred since the earlier assessment. Even in buffer plots and plots sprayed with diesoline alone, mortality was 2·2—13·6 per cent. higher than in control plots.

Thus, both BHC and Toxaphene seem to remain toxic for a considerable time and therefore mortality figures obtained during the previous bagworm season now appear to be incomplete.

When using the above-mentioned insecticides in experimental plots in the future, assessment of mortality will be made after one and two week intervals and thence at monthly intervals till July or August following.

Mortality counts were taken in plantations sprayed commercially with Toxaphene at Redgate and Boughton. At Redgate, two blocks were treated with 2·5 per cent. Toxaphene in oil, applied by Bean Fire Fighter pumps. The mortality due to the insecticide, assessed four and six weeks after spraying, was very low, not exceeding an increase of 2·8 per cent. over the natural mortality. This was due to the fact that the spray barely touched the lower part of the crowns of wattles 30—40 feet high.

For spraying at Boughton, the Natal Tanning Extract Company's Tifa was again used and rows of brushwood as well as standing trees were sprayed with 5 per cent. Toxaphene in oil. The bagworms were mainly in their fifth instar; 11 per cent. were in their prepupal stage. The cover obtained with the insecticide was good only in brushpiles, which were completely penetrated. On spraying standing wattles, adverse winds kept the fog down and the crowns were not enveloped. Ten days after spraying, the mortality due to insecticide was 64·3 per cent. in brushpiles, but nil in standing trees.

Field spraying during the copulation and pre-hatching period. At the request of the Pietermaritzburg Corporation Wattles Department advised by the Institute, approximately 20 acres of heavily infested wattle at Henley Dam were sprayed in August with a 3 per cent. solution of Toxaphene by the Estates Department of the Natal Tanning

Extract Company, using the Tifa machine. The assessment of mortality was done by the Institute. The aim of this experiment was to determine whether spraying during the copulation and pre-hatching period can stop or reduce the hatching. Spraying was done in the early morning during a light drizzle and the cover obtained was exceptionally good.

Sheets one yard square were laid on the ground to collect the dead males. The average number of dead males found 24 hours, 7, and 14 days after spraying was 12, 18, and 19 respectively per sheet in sprayed and 1, 6, and 16 respectively in unsprayed areas.

All bags taken for the assessment of mortality were dissected and 99 per cent. of males were found to have emerged. The mortality due to insecticide of females was 41·3 per cent. The females affected by the insecticide were darker in colour and broke up very easily.

Bagworm silk from inner bags was examined by the Chemistry Section to determine the labile chlorine content. The results of the examination of two sets of three samples, each containing silk from 94—104 bagworms, are given below as milligrams of labile chlorine per gram of silk:

	1st Series	*2nd Series*
1.—Unsprayed	0·36	0·13
2.—Sprayed with 3 per cent. Toxaphene, females alive	0·98	1·15
3.—Sprayed with 3 per cent. Toxaphene, females dead	17·10	11·77

It is clear that there was greater penetration of insecticide into the bags where the females died than into the other sprayed bags, although the spraying rate was the same.

In the combined sample 2, only eight bags contained fertilized eggs, while in sample 3 all bags contained fertilized eggs; some bags contained hatching or already hatched bagworms, which died within the bag. This seems to indicate that the insecticide penetrated through the copulation hole made by the abdomen of the male into the neck of the bag containing the female.

Samples of bagworms from sprayed and unsprayed areas were placed in the insectary. All bagworms from the sprayed areas, which hatched some time after the spraying, dropped directly from the bag to the ground, were unable to reach the food plant, and died within 24—48 hours, while bagworms hatched from unsprayed areas were healthy and established themselves on wattle.

At the beginning of the season, the sprayed plantation showed a decidedly lower bagworm population than the adjacent unsprayed area. Prevailing winds, however, from the unsprayed towards the sprayed area, and later lack of food in the unsprayed and heavily infested area, caused movements into the sprayed area.

These are only preliminary findings and further work in this direction will be done during the bagworm season of 1951.

3. Development of Starving Bagworms.

Bagworms in their fifth and sixth instar have been taken from felled plantations and placed in the insectary. They are periodically examined and will be kept under observation until September—October, 1951, to see whether bagworms left in their later instars without adequate food reach the pupal stage without passing through the normal number of instars, and if so, whether they emerge and are able to reproduce.

4. Loss of Bark Increment Due to Bagworm Damage.

Thirty-two plots were laid out in four plantations to determine the loss of increment due to bagworm damage. In 16 plots, all bagworms were removed from trees and the numbers recorded. Measurements of height and girth will be taken by the Silviculture Section at the end of the growing season, 1951.

5. Parasites of Bagworms and Other Wattle Pests.

Diptera:

Carcelia evolans Wied.

Tachina fasciata segregata Rond.

Coleoptera:

Diphyllus clavatus Arr., which hitherto has been thought to be a fungus feeder.

Larvae belonging to the family *Cleridae* and the genus *Opilio* or a related genus.

Hymenoptera:

A *Tetrastichus* species, new to the British Museum and previously undescribed.

Seven different species of spiders were found to be preying on wattle bagworms; they belong to the families:

Argyopidae, Clubionidae, and *Salticidae.*

A secondary parasite found on *Carcelia evolans* was identified as belonging to the *Eurytoma* species, and was previously undescribed.

Parasites of other wattle insects were found and identified as follows:

on larvae of *Pachypasa capensis* Aur. (? P. *truncata* Wlk.)

Tachina (*Podotachina*) *sorbillans* Wied.

Sturmia (*Prosturmia*) *idonea* B.B. This species is new to the British Museum and previously undescribed.

on pupae of *Gonometela postica* Wlk.

Sturmia (*Prosturmia*) *patruelis* Mesnil 1949.

6. Control of Bagworm Migration.

A site was prepared at Bloemendal for the planting of four rows of *Pinus patula* in spacing nine feet by nine feet around a block of wattles on the side of the prevailing winds.

7. Spraying Equipment.

Hand-operated pressure sprayers, equipped with atomizing nozzles, can be used only in young plantations up to 12 feet high.

The Bean Fire Fighter, being primarily equipped for fire fighting, is wasteful in using insecticide and, having a very limited reach, cannot be used for spraying older plantations.

The Tifa has proved to be suitable for the application of insecticides. The reach of spraying under favourable weather conditions is sufficient to cover trees up to 40 feet high. The new exhaust pipe constructed on the recommendation of the Institute is fitted with a lever which facilitates quick changes of angle of projection with changing conditions of atmosphere and ground. It would be advantageous to change the mounting of the Tifa as a Jeep is too light to carry the apparatus, insecticide, driver, and operator for a long time without major repairs.

It is hoped to import a portable insecticidal fog generator soon, primarily for experimental purposes, but also in order to test its suitability for dealing with small centres of infestation.

8. Control Measures.

The late discovery by some wattle growers of the severe bagworm infestation in some parts of the wattle area has led the Institute to recommend drastic measures used only in emergency. Plantations of strippable or nearly strippable age, where the infestation was noticed very late in the season, have to be cut, stripped, and the brushwood contoured and burned as soon as the foliage and twigs have dried. In this way only a partial burning takes place and the scorched thicker branches are left to provide a barrier against erosion.

9. Froghopper.

Thirty-eight acres of young wattles in Newlands Estate infested with froghopper were sprayed in September, 1950, by the Estates Research Department of the Natal Tanning Extract Company. One per cent. oil solution of Toxaphene was applied at the rate of three gallons per acre by means of the Tifa. The assessment of the effect of spraying was done by the Institute.

Sample sweeping the day before spraying showed an average population of eight froghoppers (nymphs and adults) per sweep, and 16 froghoppers were collected per square yard of catch-sheeting on shaking the tree.

Twenty-four hours after fogging, an average of three froghoppers, one alive and two dead, was caught per sweep and ten dead froghoppers were found per square yard of catch-sheeting. This latter number increased to 12 on shaking the tree. One week after fogging, an average of 0·2 live froghoppers was caught per sweep and 14 dead froghoppers were found per square yard of catch-sheeting. No dead froghoppers were caught during sweeping, and the number of dead froghoppers on the catch-sheeting did not increase on shaking the sample tree.

The young wattles in the sprayed area do not show visible froghopper damage, while wattles in the lower, unsprayed control area and also selected unsprayed sample trees show visible damage.

The wattles in the higher, unsprayed control plots alongside a stand of older wattles do not show visible froghopper damage.

10. Chafer-beetles and Cutworms.

(*a*) During experimental brush burning by the Natal Tanning Extract Company on their Newlands Estate, the opportunity was taken to determine the effect of such operations on the larvae of chafer-beetles in the soil.

Five replicates of nine plots, each plot containing one pit, three feet square and one foot deep, were laid out in May. Some pits were dug under and some next to the brushpiles which subsequently were burnt.

The larvae found in the sample pits were those of *Hippopholis sommeri* Burm. and *Anomala caffra* Burm.

Only a negligible number of cockchafer larvae (3—5 per cent.) was killed by the heat and then only where large, compact areas (one acre or more) were burnt. The burning of the customary narrow brushpiles had no harmful effect on the cockchafer population. The larvae dug in deeper and migrated from under the burning brushpile to the adjacent unburnt areas.

Another experiment consisting of five plots was laid out to determine the temperature below the surface of the soil during burning of brushpiles.

The temperature at the base of the brushpiles rose in 30 minutes after setting the piles on fire to 850°—903°C. The temperature 0·5 inches below the surface of the brushpiles rose in 30 minutes from 18°C. to 90°—95°C., and one inch below from 18°C. to 20°C., while the temperature four, six, and ten inches below the surface remained at 17°C.

(*b*) Two different brands of soil insecticide of the same gamma-benzene hexachloride content were tried at four different rates of application on five acres of a progeny trial at Bloemendal to protect the wattles against cutworm and also to test different rates of application.

(*c*) At the request of the Rhodesian Wattle Company Limited, the cause of extensive damage in young wattles was investigated and the insects damaging the plantations were identified as *Anomala resplendens* Fahr., *Anomala sp. nr. pinguis* Pering, and *Eulepida mashona* Arrow.

As the life cycle of these beetles is only partly known, three field insectaries as designed by the Institute have been erected by the owners in the Melsetter-Chipinga district. Observations there are carried out by the Company's local field staff, acting on the directions of the Institute.

By arrangement with the Company, two large-scale experiments were laid out over an area of 108 acres to determine the best methods of applying soil insecticides against larvae of chafer-beetles in areas to be planted and also in young wattles already planted.

It is hoped to gain through these experiments information of value to the whole wattle industry.

11. Insectivorous Birds.

The yellow weaver bird (Hyphantornis subaureus subaureus) which has been reported to destroy bagworms was observed not only to kill and eat bagworms in infested plantations, but also to carry whole bags to its nest to feed the young brood with bagworms pulled out of the bag near the nest. Numerous empty bags were found under trees with colonies of weaver birds.

The Indian myna (Acridotheres tristis) behaved similarly, but only where bagworms were to be found in abundance not far from their nesting places.

The brown-hooded kingfisher (Chelicutona albiventris albiventris) was observed to invade bagworm-infested plantations in large numbers. Mainly bagworms wandering on the ground in search of food were killed and extracted from the bag. In a few cases the full bag was taken to the nearest tree and the bagworm pulled out. Such bags showed usually a large gash from the neck towards the middle.

The fork-tailed drongo (Bhuchanga adsimilis adsimilis) also was seen to tear bagworms from their bags. This was only done on trees, never on the ground.

The green white-eye (Zosterops virens virens), reputed to hunt for bagworms, was also seen to invade and busily search brushpiles containing bagworms. An actual kill, however, was not observed. The green white-eye seems to be too small and not strong enough to be able to extract a bagworm from its bag.

Hadedah ibis (Hagedashia hagedash hagedash). The gut from each of 21 hadedah ibises from different parts of the wattle area was examined and the contents identified and compared with the different insects found in and around the place where the birds were seen feeding and killed. The gut contained in some cases over 270 insects and they were mainly larvae belonging to the families *Elateridae*, *Tenebrionidae*, *Tortricidae*, *Noctuidae*, and *Scarabaeidae*. Pupae of the families *Noctuidae* and *Saturnidae* and adult click beetles, crickets, spiders, grasshoppers, centipedes, and millipedes were also found. One gut contained 161 wattle seeds.

The same insects were usually found in and around the places where the birds were killed except in three cases where the gut contained a large number of larvae of the family *Tipulidae*, which live on very marshy ground and in the beds of ponds and streams. The birds apparently fed on marshy ground before alighting to feed in wattle plantations.

12. Insectary and Cage Breeding.

Bagworms from areas sprayed with insecticides are being kept under observation to determine the effect of insecticides on bagworm parasites.

Chafer-beetle eggs and larvae are being reared to determine the species and life cycle.

(e) MISCELLANEOUS.

1. Collaboration with Other Organizations.

(*a*) *Studies on the tannins of wattle species.* Further authentic samples of fresh black and green wattle bark have been sent to the Leather Industries Research Institute for their work on the chemistry of the bark tannins. These samples are collected by the Silviculture Section using a special technique which ensures that the minimum of physical and chemical change takes place before the tannins are extracted.

(*b*) *Chemistry of wattle wood, seeds, etc.* A programme of investigations has been worked out in collaboration with the National Chemical Research Laboratory of the Council for Scientific and Industrial Research. This includes work on the chemistry of wattle gum, wattle seed, the colouring matter and perfume of wattle flowers, and wattle

timber. The last named is the major project involved and is designed to produce comparative results for wattle timbers grown under a variety of environmental conditions. The results obtained will be of great value to any party interested in the chemical utilization of wattle wood. The first batch of samples prepared by the Silviculture Section has already been sent to Pretoria and the Institute, in turn, has carried out a tannin analysis on one of the products isolated. Further samples will represent not only different environments, but also different ages of tree, different positions in the tree, and different seasons of felling.

2. Wattle Utilization.

(*a*) *Floor-block manufacture.* The large scale experiment started last year has shown that the conversion of wattle timber to floor-blocks is quite a practicable and economic proposition and that the product compares favourably with other high-quality blocks.

(*b*) *Pulp manufacture and other chemical conversion.* Some of the problems arising from the possibility of converting wattle timber to pulp, notably power and water supply, have been further explored with the appropriate authorities. The interest in chemical utilization has broadened and technical data have been supplied to several interested industries. Arrangements have also been made for the supply of samples for investigations and trial overseas.

3. Wattle Timber Survey.

The response to the questionnaire circulated towards the end of 1949 has provided an almost complete picture of the position in Zululand and on the estates of the large companies. Elsewhere, however, it can be regarded only as a sample, very inadequate in some districts, of the rest of the Industry.

PROGRESS REPORTS AND PAPERS

PRE-SOWING TREATMENT OF WATTLE SEED.

By A. A. MOFFETT.

Introduction.

The writing of an article on wattle seed treatment was prompted by two considerations. First, because enquiries received at the Wattle Research Institute show that all wattle growers are not familiar with the methods of treating seed and secondly, because a considerable amount of information of practical importance has emerged from a series of germination trials designed to determine the best method of treatment for genetical investigations. The primary purpose of the article is to give information of practical importance but, at the same time, it is felt that some understanding of the problem involved and of the background of experimental results on which recommendations are based will give a clear picture of the procedure.

Why Seed Treatment is Necessary.

The wattle, in common with many other leguminous plants, produces what are known as "hard" seeds, i.e., seeds which, owing to their impervious coats, are unable to absorb the water necessary for germination. Under natural conditions of the plantation floor, this impermeability is gradually broken down, but the process may be very slow and it does not proceed at the same rate in all seeds. The result is that portions of the seed are continually being brought to a state in which they can absorb water and germinate. These portions may represent a small percentage of the total seeds in the soil, but normally, so great is that total that the natural germination is adequate for re-establishment. When, however, it is desired to establish a new plantation, or to produce more effective germination by sowing in an old without resorting to burning of the plantation floor, some form of seed treatment is necessary. Since the failure of germination due to hard seeds lies solely in seed-coat impermeability, the purpose of the treatment is to render the seed-coat permeable, and any method which will do this without damaging unduly the living part of the seed, or embryo, will stimulate germination. For example, the highest germination obtained so far resulted from making a small cut in the seed coat to allow the passage of water, while soaking the seed in sulphuric acid produced germination up to 80 per cent. The embryo itself requires no treatment other than release from the bonds of an impervious seed coat. Treatments involving heat or chemical are, in fact, detrimental to the embryo to a greater or lesser degree. The problem is, therefore, to find a treatment which will produce the maximum seed coat permeability with the minimum of damage to the embryo.

Experimental Results.

While the highest germination of wattle seeds was obtained by nicking the seed coat and this method has been used to induce germination of seed for all genetical investigations, there is no doubt that hot water treatment is the most convenient method for commercial practice. Hot water is effective to a greater or lesser degree over a wide range of treatments, but there appears to be a fairly well defined optimum point at which the maximum seed coat permeability is produced with the minimum of damage to the embryo. In this connection, a brief summary of some of the experimental results is of

interest. In Table I is shown the effect of a range of severity of hot water treatments on two samples of seed. One sample was hand-picked from the trees and was, therefore, all of the same age, while the other consisted of "commercial" seed, i.e., seed collected from the floor of the plantation. In each case, seed was germinated both in the laboratory in dishes and outdoors in soil, so that a comparison between the two methods could be obtained.

TABLE I.

Germination of hand-picked and commercial seed following a range of hot water treatments.

Type of seed and place of germination	Percentage germination					
	60°C. (140°F.)	70°C. (158°F.)	80°C. (175°F.)	90°C. (194°F.)	Boiling point	5 mins. boiling
Hand-Picked in Dishes..	44·1	67·8	90·8	91·6	90·4	63·2
Hand-Picked in Soil ..	30·8	53·4	73·6	82·9	80·9	43·7
Commercial in Dishes ..	31·4	63·2	93·2	97·6	96·7	92·9
Commercial in Soil ..	31·4	53·4	91·1	96·0	89·2	85·7

It will be noted that the maximum germination is obtained some 18°F. below boiling point and that when the boiling is prolonged for even a short period, there is a sharp drop in percentage germination. This is particularly so in hand-picked seed, which is evidently not so tolerant to treatment as commercial seed.

It is, apparently, fairly common practice to boil the seed for a considerable period of time when treating for commercial sowing. Table II shows the results of boiling a commercial sample of seed for various periods and of keeping for various periods after treatment. Germination was tested in dishes in the laboratory; sown in the soil the germination would probably be considerably lower, more particularly following the severer treatments.

TABLE II.

Percentage germination of commercial seed following a range of normal and prolonged boiling treatments and varying periods of storage.

Days storage	Hot water treatment										
	80°C.	90°C.	Blg. point	½ hr. blg.	1 hr. blg.	1½ hr. blg.	2 hr. blg.	2½ hr. blg.	3 hr. blg.	3½ hr. blg.	4 hr. blg.
0	95·0	92·5	91·5	62·0	44·5	27·5	10·5	5·0	0·5	2·0	0·5
7	94·5	97·5	94·5	74·0	52·0	40·5	22·0	15·5	7·5	2·0	0·5
15	95·0	99·5	98·5	70·5	57·0	35·5	23·5	11·0	7·5	5·5	5·5
21	95·0	96·5	95·5	74·5	54·0	41·5	25·0	12·0	8·0	5·0	4·5
28	93·5	98·0	96·0	60·5*	49·5*	27·5*	11·5*	7·5*	3·0*	1·0*	0·5*
48	94·5	96·0	94·5	67·5	43·0	32·0	28·5	14·5	9·5	5·5	3·0
60	88·0	92·5	89·0	70·0	57·5	38·0	24·0	18·0	8·0	7·0	1·5
Average ..	93·6	96·1	94·2	68·4	51·1	34·6	20·6	11·9	6·3	4·0	2·3

* Fungal attack was particularly severe in these treatments.

Not only did prolonged boiling produce a marked decline in percentage germination as shown in the table, but it also produced striking differences in the susceptibility of the seed to fungal attack. Following treatment at temperatures below boiling point, it was unusual to find seeds attacked by fungi; but as the treatment increased in severity, more and more seeds were attacked just as they started to germinate. It was obvious that in many, cases seeds counted as germinated would not have survived in the soil.

Table II shows one other point of practical interest which was first noticed by J. B. & E. Osborn (1931) and that is the increased germination which results when seed is kept in dry storage for some time after treatment. In practically all treatments, germination increased considerably following 15 days storage, but showed some decline following 60 days storage. The Osborns showed, however, that seed kept for 11 months after treatment still showed a higher germination than freshly treated seed.

Recommendations.

Various methods of treating seed for commercial sowing have been recommended and all appear to be successful to a greater or lesser degree. Maiden (1906) describes methods including mixing the seed with hot embers, frying in a pan, and pouring boiling water over the seed. Sim (1947) recommends treating the seed with boiling water until 'the seed is soft enough to be cut in two without trouble by thumbnail pressing against first finger'. The Osborns made a more critical study and concluded that the methods previously advocated were unnecessarily severe. As a result of their studies, they recommended pouring the seed into boiling water, removing the vessel from the heater immediately, and allowing the seed to cool and to soak for approximately 12 hours. This method is still largely used and is, on the whole, satisfactory, but as a result of further investigations, some modifications may be recommended, both from the points of view of increasing germination and decreasing susceptibility to fungal attack. The following is recommended as routine treatment of seed for commercial plantings.

A volume of water several times that of the seed to be treated is brought to the boil in the late afternoon and the container is then removed from the fire and the water allowed to cool for about five minutes. The seed to be treated is then poured into the hot water and left to soak overnight. In the morning, the water is poured off and the seed washed in two or three changes of clean, cold water (to remove the mucilage which exudes from the seeds) and then spread out in the shade to dry. Immediately after spreading, the seed may be dusted with slaked lime, which gives a white coating and makes it more readily visible when sown on dark coloured soils. On fairly light coloured soils, the seed will show up as well or even better without lime dusting. If possible, seed should be treated two or three weeks before planting, but this is not absolutely necessary; seed freshly treated in the manner described will give a high germination.

Points on which enquiries have been received require some elaboration.

On treatment, a small proportion of seeds, usually one or two per cent., swell up, but the majority show no physical change. This need cause no concern since swelling of the seed is not necessary for treatment to be effective; in fact, treated seed when dried is indistinguishable from untreated seed.

As mentioned above, seed will keep for a considerable period after treatment without dropping in germination percentage, so that it is quite safe to keep treated seed from one season to the next. Tests are in progress to determine exactly how long treated seed may be kept without losing its germinating power.

The experimental results show that there is considerable latitude in the range of treatment and that water at temperatures considerably below boiling will produce an effective germination. Undue damage to the seed will not occur if the tin of water is removed from the fire before the seed is poured in. Continued boiling, on the other hand, is definitely detrimental.

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